NASA TT F-10,213

PRELIMINARY INVESTIGATION OF THE MINERALOGICAL COMPOSITION OF THE STONE METEORITE VENGEROVA

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Translation of "Predvaritel'noye issledovaniye mineralogicheskogo sostava kamennogo meteorita Vengerovo"
Doklady Akademii Nauk SSSR,
Vol. 84, No. 1, pp. 123-126, 1952

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON
JUNE 1966

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ABSTRACT

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Composition of the meteorite is analyzed by size, shape, structure and ore (or silicate) content. Etching, microscopy, and spectral and chemical analysis are used.

A stone meteorite dropped to the ground in the Vengerovo district of /123* the Novosibirsk oblast on 11 October 1950 at 18:49. Acting on instructions from the Committee on Meteorites of the USSR Academy of Sciences and with the cooperation of Prof. A. Ye. Malakhov, the author collected some observation data and meteorites in the autumn of that year (ref. 1). Those efforts were continued in July 1951.

The local residents had found two separate specimens. The larger one weighed 9.3 kg and had a half-oriented shape. One side of the meteorite had a pyramidal habit and was covered with a black crust of fusion of the first genus with distinct glyptic lines; its edges were blunted and rounded. This was apparently the front side. It was facing downward when the meteorite was lying in the pit. The back side of the meteorite was flat with an irregular angularity and covered with a crust of the second genus.

Author

*Numbers given in margin indicate pagination in original foreign text.

Only a small fragment, partially stripped and weighing 27 g, was left of the second specimen which, according to the finder, had weighed over 1 kg.

The author made a mineralographic investigation of the meteorite in the laboratory of ore-deposit geology of the Sverdlovsk Mining Institute under the supervision of Prof. S. A. Vakhromeyev. A small fragment of the larger specimen was used in the tests.

The fresh fracture revealed the bulk of the meteorite to be of a light gray color; black thread veinlets were observable in some parts. Structurally it was a typical chondrite with macroscopically visible chondrules up to several millimeters in size, as well as plessite inclusions, one of which had a diameter of 0.5 cm; there were traces of troilite.

Three polished and two petrographic sections were prepared for microscopic examination. The following ore minerals were identified in the meteorite under the microscope in a reflected light: plessite, troilite, chromite and native copper.

The plessite is main ore mineral, and it amounts to from 6 to 10 percent by volume. Relatively large grains, measuring from 0.10 to 0.4 mm, are predominant; they have an irregular angular shape with occasional corroded serrated edges. An etching test with a 6 percent solution of nitric acid revealed a granular structure in the plessite. A light fringe several microns wide apparently consisting of taenite was observable on the grain periphery after the etching. The central part of the grain was dark with a shagreen surface and probably consisted of plessite.

There were, in addition to the plessite inclusions, tiny dust-like /124 formations of an isometric or drop-shaped form measuring from tenth parts of a micron to several microns. Similar formations were observed both in the ground

mass of the meteorite and in the silicate chondrules. These formations were evenly scattered in the chondrules, but the droplets were more frequently concentrated in the center of the chondrule or along its periphery. In most cases the droplets were observable in the darker silicate portion of the meteorite.

In very rare cases the intergrowth of plessite with troilite results in the formation of very thin veinlets, about 1-2μ thick, which are usually confined to the black meteorite veins observable under a microscope.

The troilite content in the meteorite was 3.4 to 3.7 percent by volume. By the shape of its grains, troilite is very similar to plessite. These two minerals usually occur together, and are frequently intergrown. Special mention should be made of the inclusions of small troilite grains in the plessite, which are as a rule associated with native copper. Such grains usually have an irregular shape with angular corroded edges. Some of the grains are slightly elongated, their sizes varying from tenth parts of a micron to several microns. Such floating troilite "chips" in the plessite, as it were, are relatively rare.

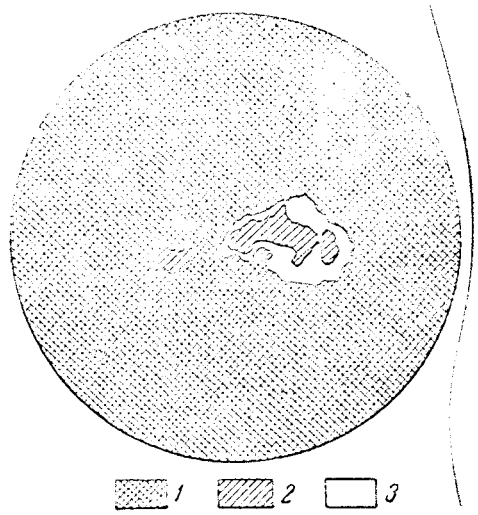

Figure 1. Troilite grain (2) surrounded by a plessite fringe (3), 1-silicates. Polished microsection 22; reflected light; magnification 300.

The plessite containing them is almost always intergrown with the large troilite grains. Troilite grains with a plessite edge along the periphery are encountered very seldom (fig. 1).

More or less round or oval troilite inclusions are occasionally found in these macroscopic black veinlets of the meteorite. These inclusions, in turn, contain tiny teardrop-shaped plessite grains measuring several microns.

The chromite content in the meteorite is insignificant, varying from 0.2 to 0.3 percent by volume. Predominant among them are grains measuring 0.04 to 0.004 mm, with the same irregular and angular shape as the plessite and troilite grains. There is a fairly wide occurrence in the meteorite of isometric and teardrop-shaped chromite formations, ranging in size from tenth parts of a micron to several microns. In most cases they are enclosed in the silicate chondrules (fig. 2, inset). Little chains of chromite with plessite droplets are occasionally seen surrounding the chondrules; they also occur in the main silicate part of the meteorite. Tiny teardrop-shaped formations of chromite are also found in the plessite.

The native copper found in the meteorite was determined by the following indications: the freshly cut and polished surface was copper-colored but turned to an intense red a few hours later because of its oxidation in the air; the reflection index was higher than that of the plessite, $R \cong 90$ percent; it had a high luster; its hardness was lower than that of plessite; as the micro- /125 scope table is raised, the luminous line shifts from the copper to the plessite it is isotropic. A diagnostic etching with HNO_3 (1:1) and HCl (1:1) has produced negative results, and the use of $HgCl_2$ 5 percent and $FeCl_3$ 20 percent produced positive results: the native copper began to turn black at a fast rate.

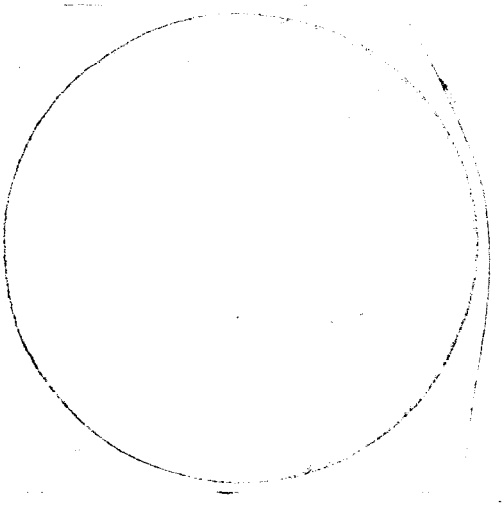

Figure 2. Tiny teardrop-shaped chromite inclusions (light gray) in a silicate chondrule. Arrows indicate teardrop-shaped inclusions of plessite (white); silicates are shown in black. Polished microsection 22; reflected light; magnification 600.

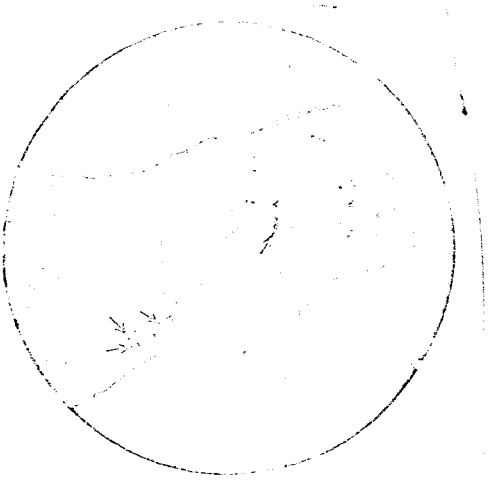

Figure 3. Oxidized native copper grains (black, indicated by arrow) included in the plessite (white). The gray color indicates troilite, and the black silicates. Polished microsection 34; reflected light; magnification 600.

A spectral analysis of the meteorite revealed faint copper lines (table 1). A complete chemical analysis of the meteorite[1] established a copper content of 0.06 percent.

The native copper grains are associated with troilite and plessite. The copper practically always occurs in the form of tiny inclusions in plessite where it is intergrown with small troilite grains to some extent or other (fig. 3). In only one case was it possible to find native copper inclusions

[1]The analysis was made by L. N. Zakharova.

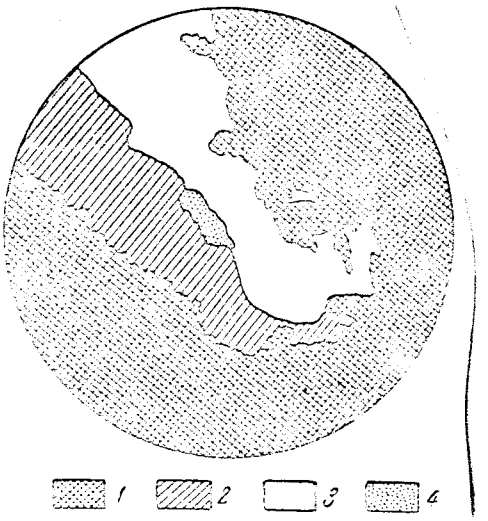

Figure 4. Native copper (4) intergrown with troilite (2) and plessite (3), 1-silicates. Polished microsection 34; magnification 650.

on the face of the intergrowth of relatively large troilite and plessite formations (fig. 4).

The grains of the native copper are irregular in shape and in most cases elongated. Minute offsets, visible only under large microscopic magnification when immersed in oil, extend from the grain edges in some areas.

The author made a thorough examination of three highly magnified polished surfaces with a total area of 5 cm^2, but found no native copper in the plessite grains which did not contain any troilite "chips."

The copper grains are very small in size, measuring not more than 0.03 mm in length and up to 0.01 mm in width, but they usually do not exceed 1/μ.

A spectral analysis of the meteorite[2] produced the following results

[2] Analysis by N. Yarosh.

TABLE 1

Mn	weak	Ni	medium	Ti	weak +
Mg	very intense	Cr	medium high	Na	medium
Si	intense	Al	intense	Cu	weak
Fe	intense	V	weak	Ca	intense
Co	weak +				

The nonmetalliferous part of the meteorite consists of the following silicates: olivine, pyroxene and vitreous mass. A microscopic examination revealed the following textures of the silicate chondrules: microporphyritic, grizzled, eccentrically radiated and polygonal-granular; the chondrules are round in shape. Some silicate chondrules are enclosed in a shell consisting of tiny troilite and plessite inclusions.

REFERENCE

1. Yudin, I. A. Priroda, No. 8, 30, 1951